N86-28409

TETHERED SATELLITE DESIGN

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PSN

SATELLITE CONCEPT

A) MISSION OBJECTIVES

- ENGINEERING TEST

  TO TEST THE CAPABILITY OF THE SATELLITE TO PERFORM A VARIETY OF SPACE OPERATIONS TO BE ACCOMPLISHED FROM THE SHUTTLE, CONSIDERING:

  - USE OF THE SATELLITE WITH MAN-IN-LOOP AND CLOSED LOOP MODES
  - DEPLOYMENT (TOWARD OR AWAY FROM EARTH, UP TO 100 KM), STATION-KEEPING, RETRIEVAL AND CONTROL OF THE SATELLITE.

- SCIENTIFIC PAYLOADS

  TO PERFORM EXPERIMENTS AND SCIENTIFIC INVESTIGATION FOR APPLICATIONS SUCH AS:

  - MAGNETOMETRY
  - ELECTRODYNAMICS
  - ATMOSPHERIC SCIENCE
  - CHEMICAL RELEASE
  - COMMUNICATIONS
  - PLASMAPHYSICS
  - DYNAMIC ENVIRONMENT
  - POWER AND THRUST GENERATION

SATELLITE CONCEPT (CONT'D)

B) REUSABLE

THE TSS-S WILL BE REUSED FOR AT LEAST 3 MISSIONS AFTER RECONFIGURATION AND REFURBISHMENT BY CHANGING THE PECULIAR MISSION ITEMS: THERMAL CONTROL, FIXED BOOM FOR EXPERIMENTS, AERODYNAMIC TAIL FOR YAW ATTITUDE CONTROL, EXTERNAL SKIN, EXPERIMENTS, ANY OTHER FEATURE

C) MODULES

THE TSS-S IS COMPOSED OF THREE MODULES IN ORDER TO ALLOW INDEPENDENT INTEGRATION OF A SINGLE MODULE AND TO FACILITATE THE REFURBISHMENT AND RECONFIGURATION BETWEEN THE FLIGHTS.
THE THREE MODULES ARE:

- SERVICE MODULE (SM)
- AUXILIARY PROPULSION MODULE (APM)
- PAYLOAD MODULE (PM)

SATELLITE CAPABILITY

- PAYLOAD

  TOTAL WEIGHT 66 Kg; 2 Kg ON THE FIXED BOOM 1.0 METER LONG (46 Kg FOR ATM MISSION)
  2000 WH OF ENERGY

- THREE AXIS ATTITUDE MEASUREMENT
- ATTITUDE AND SPIN CONTROL AROUND YAW AXIS (NO SPIN CONTROL FOR ATM MISSION)
- SPIN VELOCITY MEASUREMENT (N/A TO ATM MISSION)
- COMMUNICATION WITH ORBITER P.I. VIA S-BAND LINK FOR COMMAND RECEPTION AND TELEMETRY DATA TRANSMISSION

SATELLITE CAPABILITY (CONTD)

- CONTROL OF SATELLITE FUNCTIONS
  - MONITORS ACQUISITION
  - AMCS DATA PROCESSING
  - COMMAND DISTRIBUTION

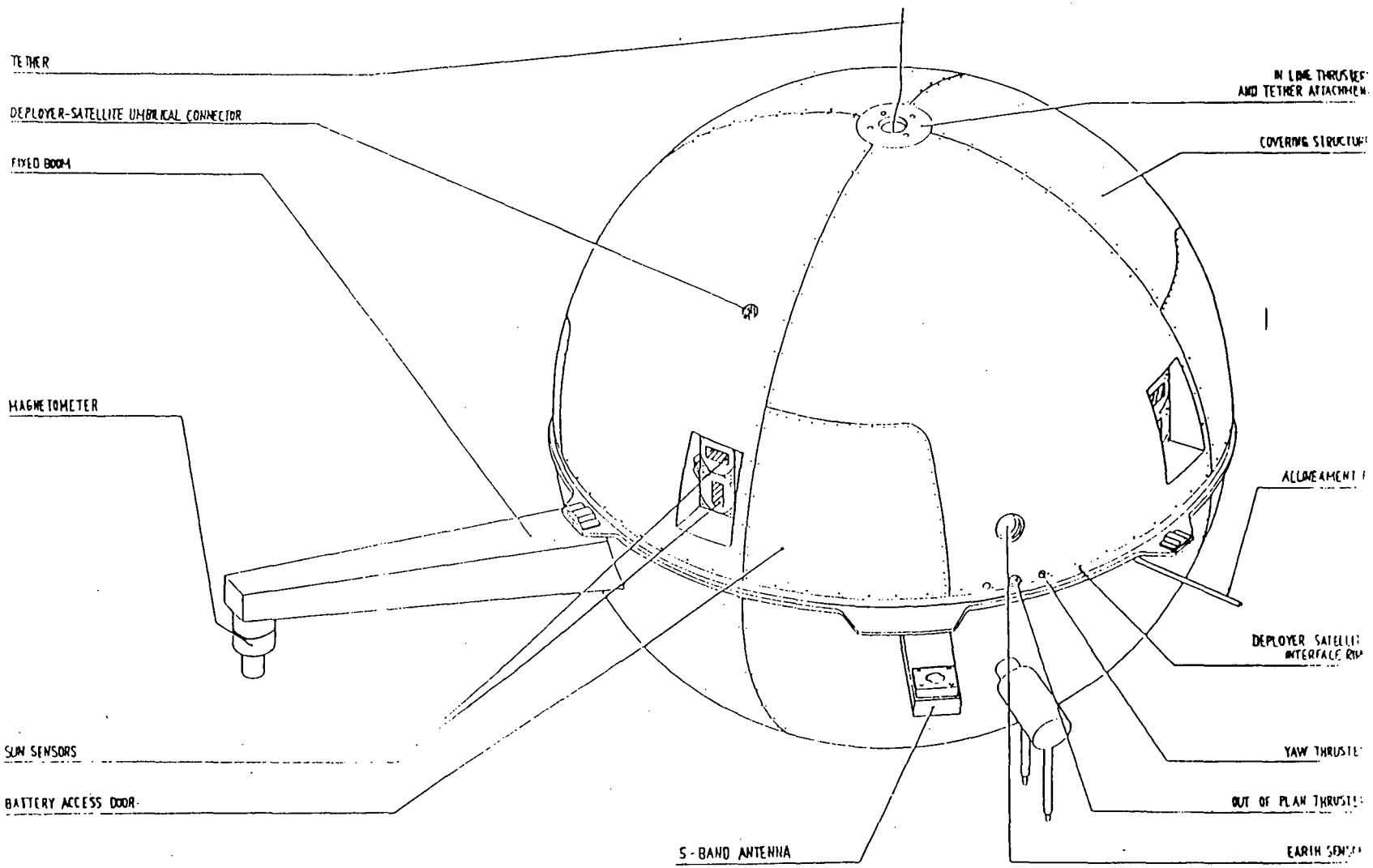
- ENGINEERING DATA MONITORING: SATELLITE TEMPERATURES, GN_2 PRESSURE, BATTERIES VOLTAGE, ENERGY AND FUEL CONSUMPTION

- OPERATIONAL SUPPORT TO THE TSS
  - IN LINE THRUSTERS TO AVOID TETHER TENSION LOWER THAN 2N
  - SIDE THRUSTERS FOR IN-PLANE AND OUT-OF-PLANE OSCILLATION DAMPING

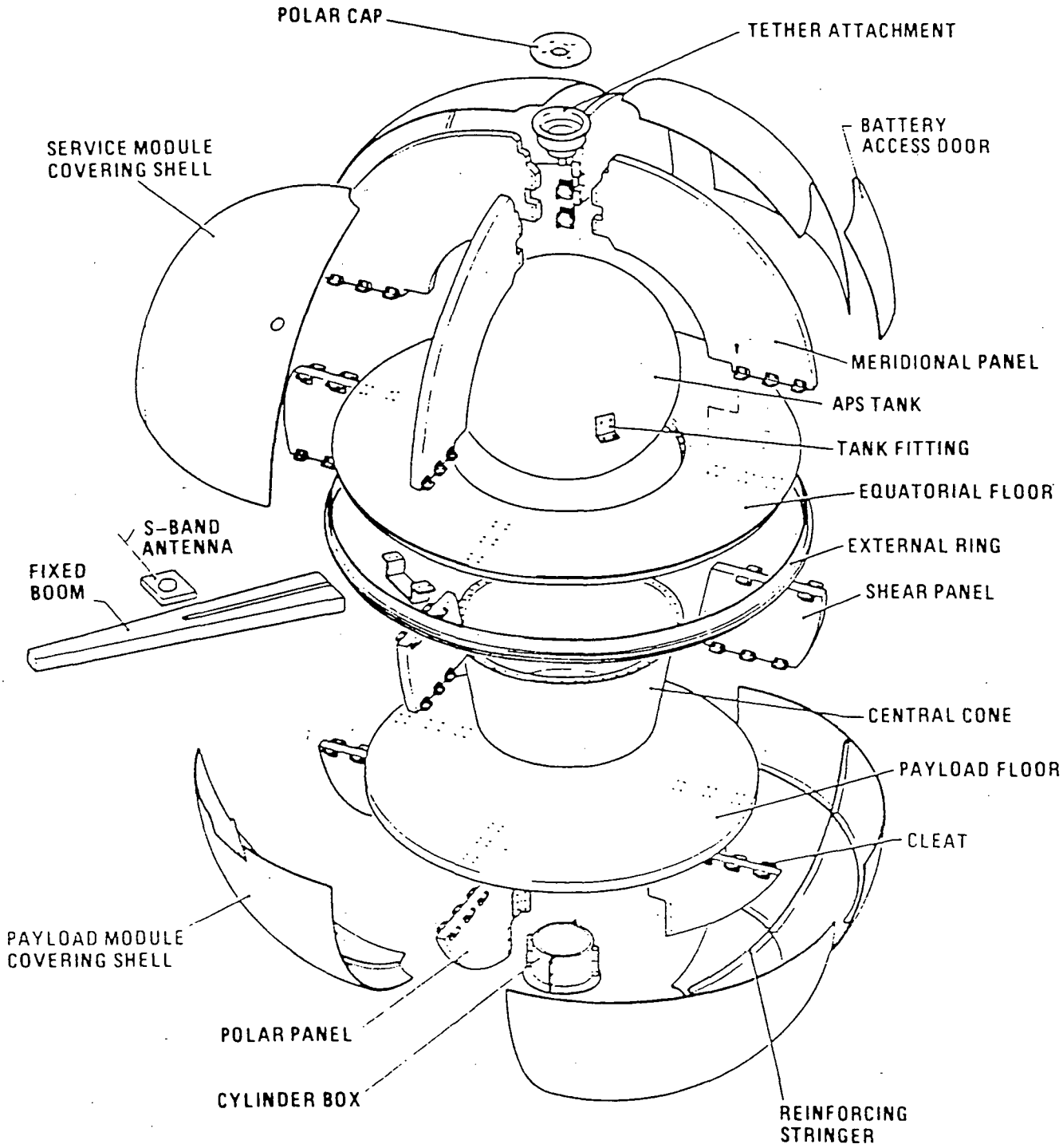
SATELLITE EXTERNAL CONFIGURATION

- SPHERICAL, 1.6 METERS DIAMETER
- WEIGHT, 500 Kg INCLUDING EXPERIMENTS
- 8 COVERING PETALS TO ALLOW THE SUBSYSTEMS AND PAYLOAD INTEGRATION/REFURBISHMENT
- 4 ACCESS DOORS FOR BATTERIES INTEGRATION AND CHANGE-OUT
- TETHER ATTACHMENT INTEGRATED IN THE IN-LINE THRUSTERS ASSEMBLY
- EQUATORIAL RING WITH 6 SUPPORTS FOR MECHANICAL INTEGRATION WITH THE DEPLOYER
- 2 SKIN CONNECTORS FOR SATELLITE/DEPLOYER ELECTRICAL CONNECTION PRIOR DEPLOYMENT
- WINDOWS FOR SUN SENSORS (4) AND EARTH SENSORS (2)
- A DEDICATED BOOM FOR S-BAND ANTENNA
- A 1.0 METER FIXED BOOM FOR EXPERIMENT
- AERODYNAMIC TAIL (ONLY FOR ATMOSPHERIC MISSION)

TSS-S ELECTRODYNAMIC CONFIGURATION



TSS–S EXPLODED VIEW

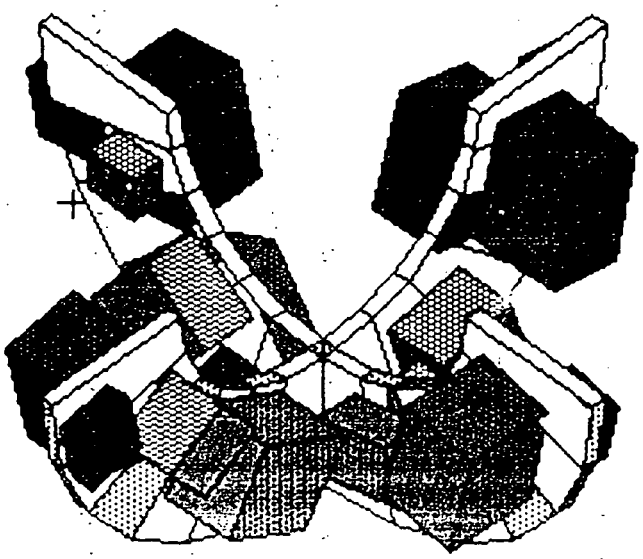


ELECTRODYNAMIC SATELLITE INTERNAL LAY-OUT

A) MERIDIONAL PANELS (4) AND EQUATORIAL FLOOR USED FOR SERVICE MODULE LAY-OUT

B) PAYLOAD FLOOR; SHEAR AND POLAR PANELS, FIXED BOOM USED FOR PAYLOAD MODULE LAY-OUT

C) EQUATORIAL FLOOR USED FOR AUXILIARY PROPULSION MODULE



3-10-85	AERITALIA - GSS - SYSTEMS ENGINEERING
	(1) SERVICE MODULE

TSS SATELLITE SCIENCE ACCOMODATION (EDY MISSION)

GEOMETRICAL AND MECHANICAL CAPABILITIES

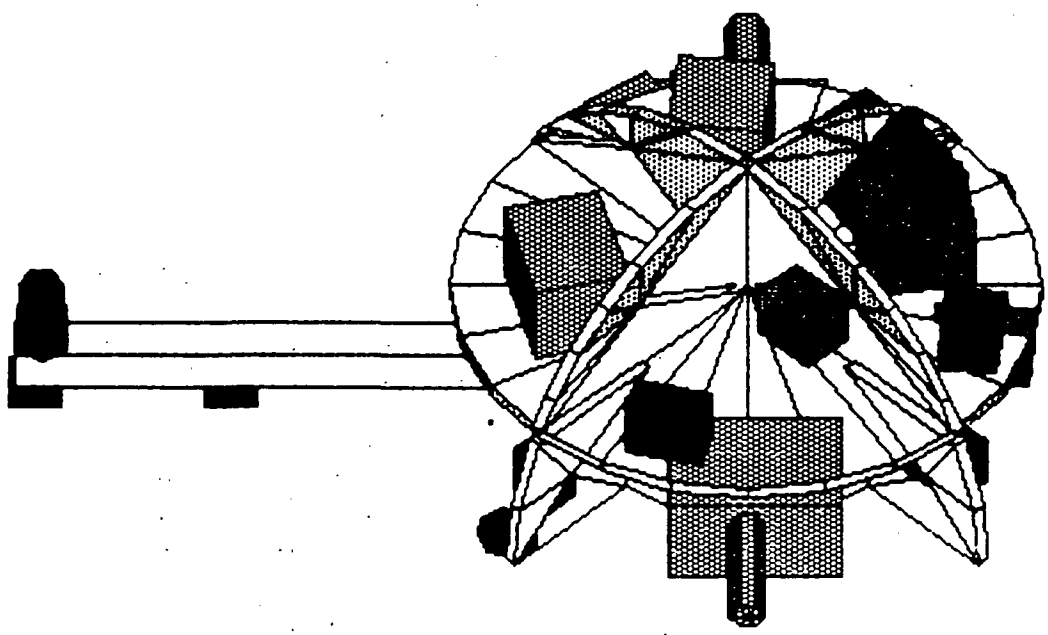
SCIENCE INSTRUMENTS CAN BE ACCOMODATED ON:

A) EITHER SIDE OF THE FOLLOWING PAYLOAD MODULE ELEMENTS:

- PAYLOAD FLOOR
- FOUR (4) POLAR PANELS
- FOUR (4) SHEAR PANELS, INTERPOSED BETWEEN THE PAYLOAD FLOOR AND THE EQUATORIAL FLOOR.

WITH:
- TOTAL FOOTPRINT AREA AVAILABLE: 2.4 M^2
- TOTAL VOLUME AVAILABLE: 0.4 M^3
- TOTAL MASS: 66 Kg

B) THE FIXED 1.0 M LONG BOOM WITH 2 Kg TOTAL MASS CAPABILITY



Space = 3000

3-10-85	AERITALIA - GSS - SYSTEMS ENGINEERING
	(3) PL/M AT LAUNCH

SCIENCE FOR THE FIRST TSS ELECTRODYNAMIC MISSION

SCIENTIFIC OBJECTVES

- STUDY OF ELECTRODYNAMIC INTERACTION BETWEEN THE TSS AND AMBIENT PLASMA
- STUDY OF DYNAMICAL FORCES ACTING ON THE TETHERED SATELLITE

SATELLITE INSTRUMENTATION

- RESEARCH ON ELECTRODYNAMIC TETHER EFFECTS (RETE) - PROF. M. DOBROWOLNY CNR/IFSI - FRASCATI - ROME
  WAVE SENSORS ON TWO EXTENDABLE BOOMS (4 m EACH) TO EXPLORE SPACE CHARGE REGION AROUND SATELLITE.
- TETHER MAGNETIC FIELD MEASUREMENT (TEMAG) - PROF. F. MARIANI - 2ND UNIVERSITY OF ROME - TOR VERGATA - ROME
  TWO MAGNETOMETERS ON FIXED BOOM (85 cm) TO MEASURE MAGNETIC FIELD AND DYNAMICS OF TETHERED SATELLITE.
  RESEARCH ON ORBITAL PLASMA - ELECTRODYNAMICS (ROPE) - DR. N. STONE - NASA/MSFC HUNTSVILLE - ALABAMA
  PARTICLE SENSORS ON FIXED BOOM (85 cm) AND ON SATELLITE TO STUDY SATELLITE PLASMA INTERACTION.

SCIENCE FOR THE FIRST TSS ELECTRODYNAMIC MISSION (CONTD)

DEPLOYER INSTRUMENTATION

- SHUTTLE ELECTRODYNAMIC TETHER SYSTEM (SETS) - PROF. P. BANKS - STANFORD UNIVERSITY - STANFORD - CALIFORNIA
  VARIOUS INSTRUMENTS TO STUDY TETHER CURRENT - VOLTAGE CHARACTERISTICS, CHARGE CONTROL AND EMISSION AT ORBITER, OTHER PLASMA AND IONOSPHERIC PROCESSES.

THEORY AND GROUND - BASED OBSERVATIONS

- THEORY AND MODELING IN SUPPORT OF TETHER - PROF. K. PAPADOPOULOS - SCIENCE APPLICATIONS, INC. - McLEAN - VIRGINIA
- INVESTIGATION ON TSS DYNAMICS - PROF. S. BERGAMASCHI - UNIVERSITY OF PADOVA PADOVA
- INVESTIGATION AND MEASUREMENT OF DYNAMIC NOISE IN TSS - DR. G. GULLAHORN - SAO CAMBRIDGE - MASSACHUSSETS
- DETECTION OF ELECTRODYNAMIC ULF/ELF EMISSIONS BY THE TETHER - PROF. G. TACCONI UNIVERSITY OF GENOVA - GENOVA
- INVESTIGATION OF ELECTRODYNAMIC EMISSIONS BY THE TETHER - DR. R. ESTES - SAO CAMBRIDGE MASSACHUSSETS.

ITALY IS RESPONSIBLE FOR THE INTEGRATION OF THE SCIENTIFIC INSTRUMENTATION ON THE SATELLITE

TSS CORE EQUIPMENT

TETHER CURRENT-VOLTAGE CONTROL (TCVC) SYSTEM

PURPOSE

FOR THE ELECTRODYNAMIC MISSIONS THE TCVC SYSTEM WILL SPECIFICALLY ALLOW INVESTIGATION OF THE TSS-S ELECTRICAL POTENTIAL BY CONTROLLING THE CURRENT THAT FLOWS BETWEEN THE SATELLITE AND THE ORBITER THROUGH THE TETHER AS A RESULT OF THE EMF GENERATED (UP TO 5 KV) BY MOTION OF THE TSS THROUGH THE GEOMAGNETIC FIELD
THIS FUNCTION IS FUNDAMENTAL TO THE OPERATION OF THE ELECTRODYNAMIC TETHER AND IS ESSENTIAL FOR THE TSS SCIENTIFIC INVESTIGATIONS.

THREE-AXIS ACCELEROMETER-GYRO SYSTEM

PURPOSE

THE THREE-AXIS ACCELEROMETER-GYRO SYSTEM WILL PROVIDE A HIGHLY ACCURATE ASSESSMENT OF DYNAMIC PERTURBATION TO THE MOTION OF THE TETHERED SATELLITE.
THIS INFORMATION IS REQUIRED TO DETERMINE THE SUITABILITY OF THE TETHERED SATELLITE AS A PLATFORM FOR A VARIETY OF INVESTIGATIONS OF CRUSTAL - INDUCED MAGNETIC AND GRAVITATIONAL EFFECTS.

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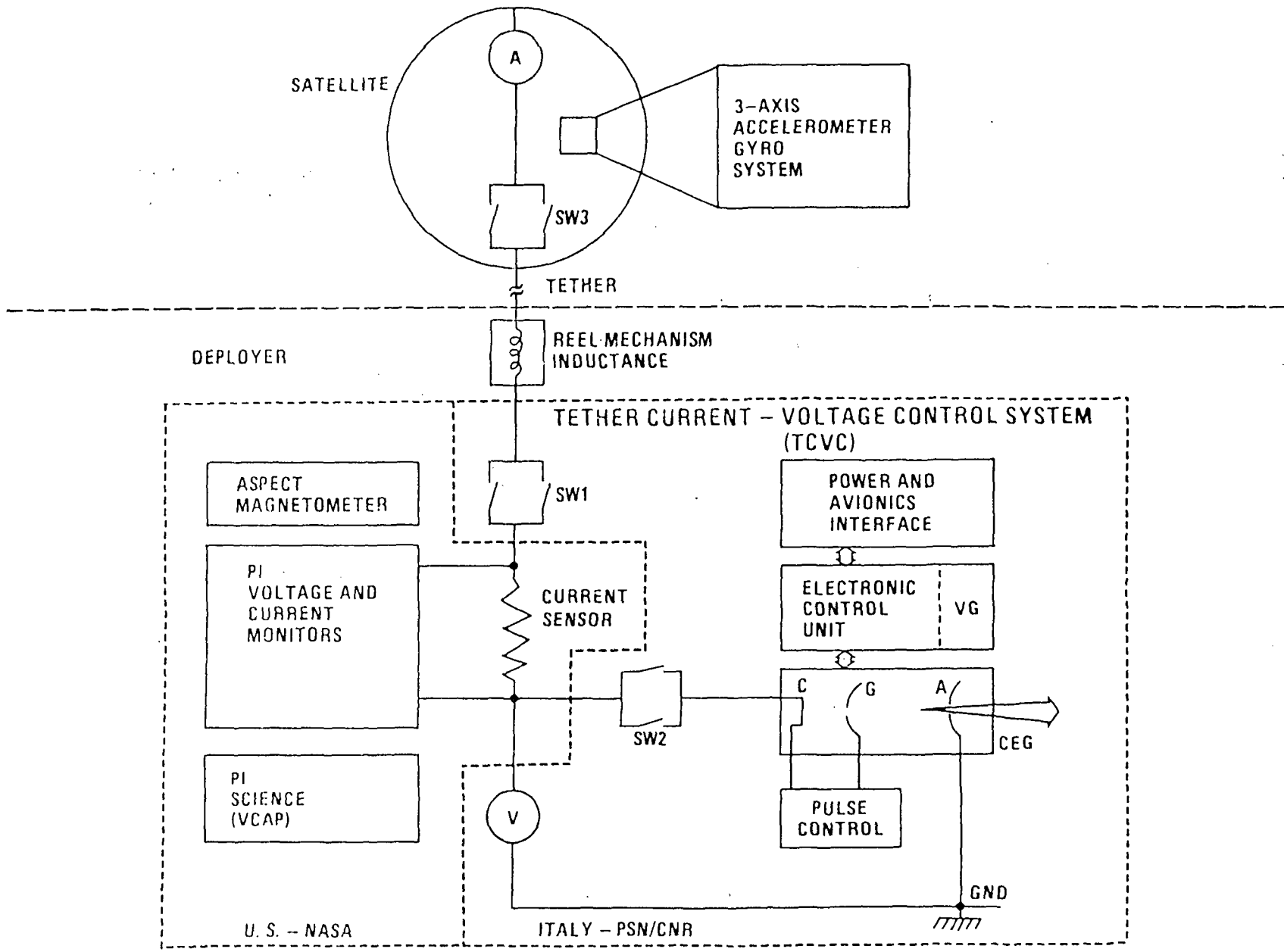
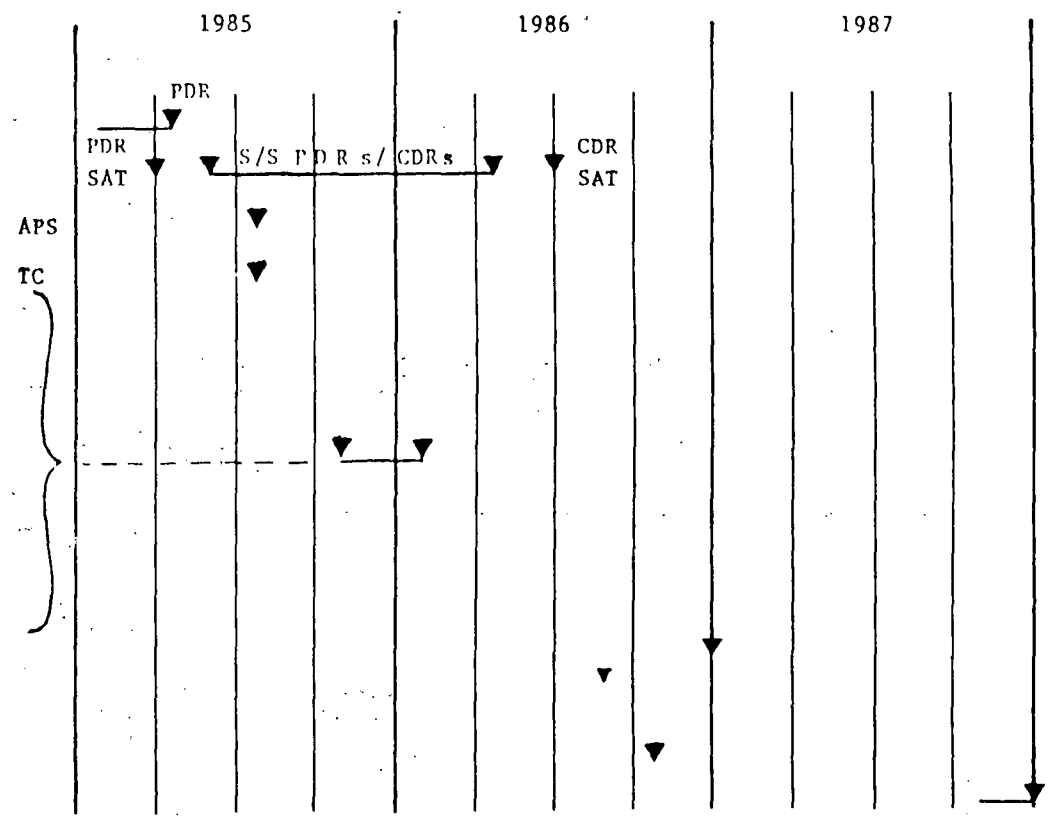
TSS CORE EQUIPMENT
(FIRST MISSION)



SATELLITE SCHEDULE (MILESTONE)



TSS REVIEW

TSS-S REVIEWS

PRELIMINARY DESIGN REVIEW

" " "

" " " HARNESS
" " " SMS
" " " AMCS
" " " OBDH
" " " EPDS
" " " TT&C
" " " EGSE
" " " MGSE

PAYLOAD DELIVERY TO A I T

PAYLOAD EM's/SIM's DELIVERY TO AIT

INTERFACE SIMULATORS

FU DELIVERY TO MMA AT DENVER